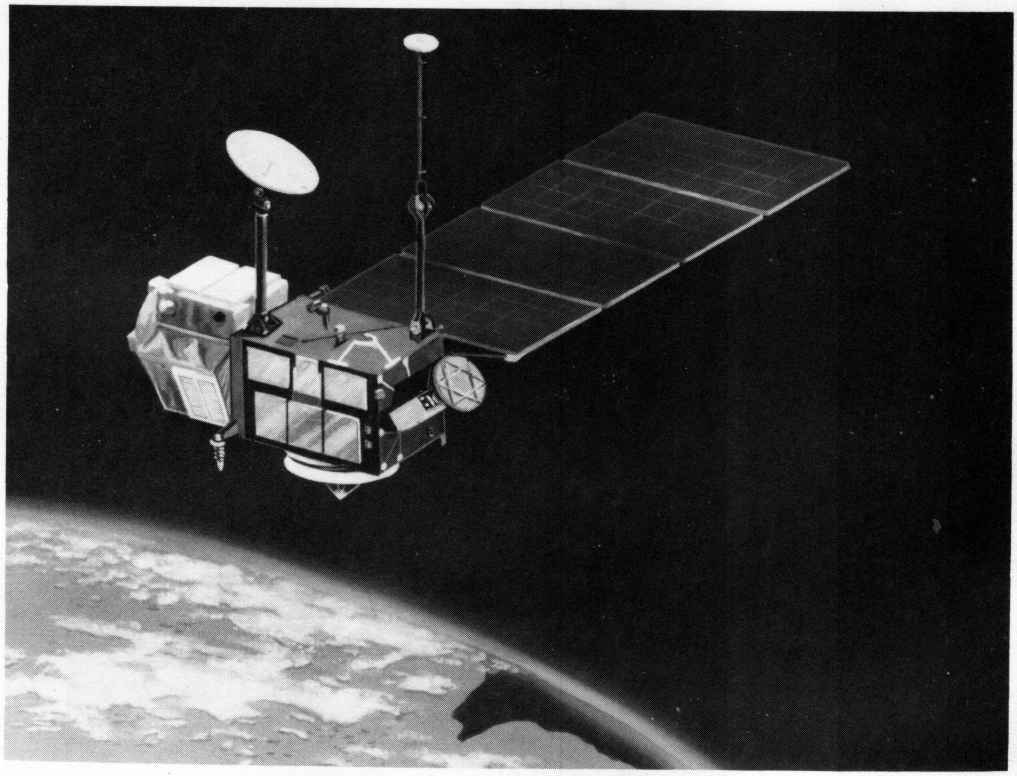
FACT SHEET



TOPEX/POSEIDON

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NASA's Jet Propulsion Laboratory and the Centre National d'Etudes Spatiales (CNES), the French space agency, are turning their scientific sights on Earth with a joint satellite mission designed to map the circulation of the world's oceans.

The Ocean Topography Experiment, or Topex, has been combined with France's Poseidon mission. Together, the Topex/Poseidon satellite will be the most sophisticated attempt yet to measure and map sea level from space.

Topex/Poseidon is scheduled for launch in mid-1992 aboard an Ariane 42P booster rocket. Arianespace, under contract with CNES, will launch the satellite from its Guiana Space Center in Kourou, French Guiana.

Designed for a three- to five-year mission, Topex/Poseidon's primary science goal is to improve our understanding of how the oceans circulate. Such information will allow oceanographers to study the way the oceans transport heat and nutrients and how the oceans interact with weather patterns. Such studies will increase our understanding of the ocean's role in global change.

In the past, oceanographers have studied the sea from ships. This provided only a snapshot of the oceans' character because the ships took spotty measurements from fixed locations. Topex/Poseidon will provide a long-term, coherent, panoramic picture of the oceans. Such global information offers potential societal benefits such as improved long-range weather

forecasting.

Topex/Poseidon will also aid in efforts to predict phenomena such as El Niño, an unusual water warming that occurs in the eastern Pacific and has been associated with global weather changes that have caused billions of dollars in damage worldwide.

MISSION OVERVIEW

The main instrument on the Topex/Poseidon satellite is a radar altimeter. This device is similar to ones that were flown on NASA's GEOS 3 satellite in 1975, on Seasat in 1978 and on the U.S. Navy's Geosat in 1985.

As Topex/Poseidon orbits the Earth, the altimeter bounces radar signals off the ocean's surface. The device records the time it takes the signal to return to the satellite and that gives it a precise measurement of the distance between Topex/Poseidon and the sea surface.

This data will be combined with measurements from other instruments that pinpoint the satellite's exact location in space. Scientists will then be able to produce a detailed map of ocean topography, or sea level relative to the Earth's center.

Sea level is directly related to ocean currents, eddies and other features of the ocean surface. When they examine the influence of the Earth's gravity field on sea level, researchers will also be able to study major features on the ocean floor. Information contained in the radar return signals can also be

used to calculate wave height and wind speed, two elements that are important for monitoring the global sea state.

Planning by NASA and CNES calls for the United States to provide the satellite, altimeter, a microwave radiometer, an experimental satellite tracking receiver and various spacecraft subsystems. The French will supply the launch vehicle and two other instruments -- a solid-state altimeter and a Doppler tracking receiver.

In 1987, an international team of 38 principal investigators was selected to participate in the Topex/Poseidon mission through a joint U.S.-French announcement of opportunity. These scientists have been working closely with the project to refine the mission design and scientific plans. After launch they will conduct a wide range of oceanographic and geophysical studies to accomplish the mission science goals.

Topex/Poseidon will complement other important oceanographic experiments planned for the 1990s:

-- **The European Remote Sensing Satellite** (ERS-1), launched by the European Space Agency, carries an altimeter and a scatterometer in addition to other instruments. The altimeter, when used in conjunction with Topex/Poseidon data, will increase the sampling and coverage area. The scatterometer's measurements of global wind speed and direction, together with the altimetric sea-level measurements, will help scientists study how winds produce ocean currents and waves.

-- The **NASA Scatterometer** (NSCAT) is a JPL-managed

instrument scheduled for launch aboard the Japanese Advanced Earth Observing Satellite (ADEOS) in February 1995. NSCAT will make frequent measurements of wind speeds and direction over the global ocean.

Oceanographers from around the world will also conduct studies using Topex/Poseidon data as part of the World Ocean Circulation Experiment (WOCE) and the Tropical Oceans Global Atmospheres Experiment (TOGA). These decade-long programs are sponsored by the World Climate Research Program.

SATELLITE DESIGN

Fairchild Space of Germantown, Maryland, is providing the spacecraft which is based on NASA's Multi-Mission Spacecraft (MMS) design.

Topex/Poseidon will orbit the Earth at a relatively high altitude of 830 miles (about 1,340 kilometers). This will minimize atmospheric drag on the spacecraft, reduce the influence of errors in measuring Earth's gravity field, and simplify maneuvers needed to maintain the orbit position. The satellite orbit will be inclined 66 degrees from Earth's equator.

The satellite's position in space must be known as precisely as possible in order to produce extremely accurate maps of sea level. Special laser and radio tracking on the ground will pinpoint Topex/Poseidon's position to within five inches (13 centimeters). By comparison, the orbit of Seasat was known to an accuracy of 20 to 40 inches (50 to 100 centimeters).

The NASA radar altimeter will operate at two frequencies, 13.6 and 5.3 gigahertz. Measurements of the same ocean area taken at both frequencies will help correct for path-delay errors caused by electrons in the ionosphere.

A microwave radiometer, built by JPL, will measure radiation emitted from water vapor between the satellite and the ocean. This will be used to correct for path-delay errors caused by atmospheric water vapor.

The French space agency will provide an experimental solid-state altimeter on board the satellite. This altimeter operates at the single frequency of 13.65 gigahertz. It is provided under contract to CNES Toulouse Space Center by Alcatel Espace Systems. The two altimeters will share the same antenna with the NASA altimeter being turned off a small part of the time so the French instrument can operate without interference.

The French will also provide a new radio-tracking system that will measure the position and velocity of the spacecraft. It is called Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS) and is a dual Doppler receiver which operates with a network of 50 uplink ground stations. DORIS is provided under contract to CNES by Electronique Serge Dassault and will be used with the laser tracking system.

The United States is conducting a Global Positioning System precision orbit determination experiment along with this mission to test a new high-precision tracking system. A GPS

demonstration receiver is being built by Motorola Inc. of Chandler, Arizona, under contract to NASA/JPL. It receives tracking signals from the constellation of Navstar satellites established under the GPS program. Tracking information is sent to the ground for processing in the test ground operations system.

MISSION BENEFITS

The results of the scientific studies using data from Topex/Poseidon will increase our understanding of the ocean's role in global change and are expected to provide information about specific environmental problems.

-- **Carbon Dioxide.** The burning of fossil fuels, combined with deforestation, is causing a significant increase of carbon dioxide in the atmosphere. This could ultimately produce catastrophic warming of the Earth. The impact appears to be critically dependent upon how fast carbon dioxide is absorbed by the ocean and how efficient the ocean interacts with the atmosphere to slow down the potential global warming. Both factors rely, in part, on ocean currents. Detailed knowledge of ocean circulation could help scientists determine what threat increased carbon dioxide in the atmosphere may pose for the Earth's future.

-- **Weather Forecasting.** Weather patterns in North America are heavily influenced by events over the ocean -- in this case, the Pacific. Analysis of Topex/Poseidon data will eventually

help forecasters predict general weather trends a season ahead, enabling the agriculture industry to adjust crop selection. Such predictions would also benefit energy planning in the Northeast United States by forecasting unusually cold or warm winters.

-- **Offshore oil, mining, and coastal power plants.** Such facilities must be designed to withstand severe wave and storm surges, such as those caused by hurricanes along the United States' Gulf Coast. Observations from Topex/Poseidon will provide information for better planning in the location and construction of oil rigs, drill ships, mining operations and coastal nuclear power plants.

-- **Seabed disposal of dangerous wastes.** The safety of such disposal depends partly on the rate at which currents may carry potentially hazardous leakage from disposal sites toward fishing grounds and coastal areas.

Topex/Poseidon is managed by JPL for NASA's Office of Space Science and Applications. Charles Yamarone of JPL is the project manager and Dr. Lee-Lueng Fu of JPL is project scientist.

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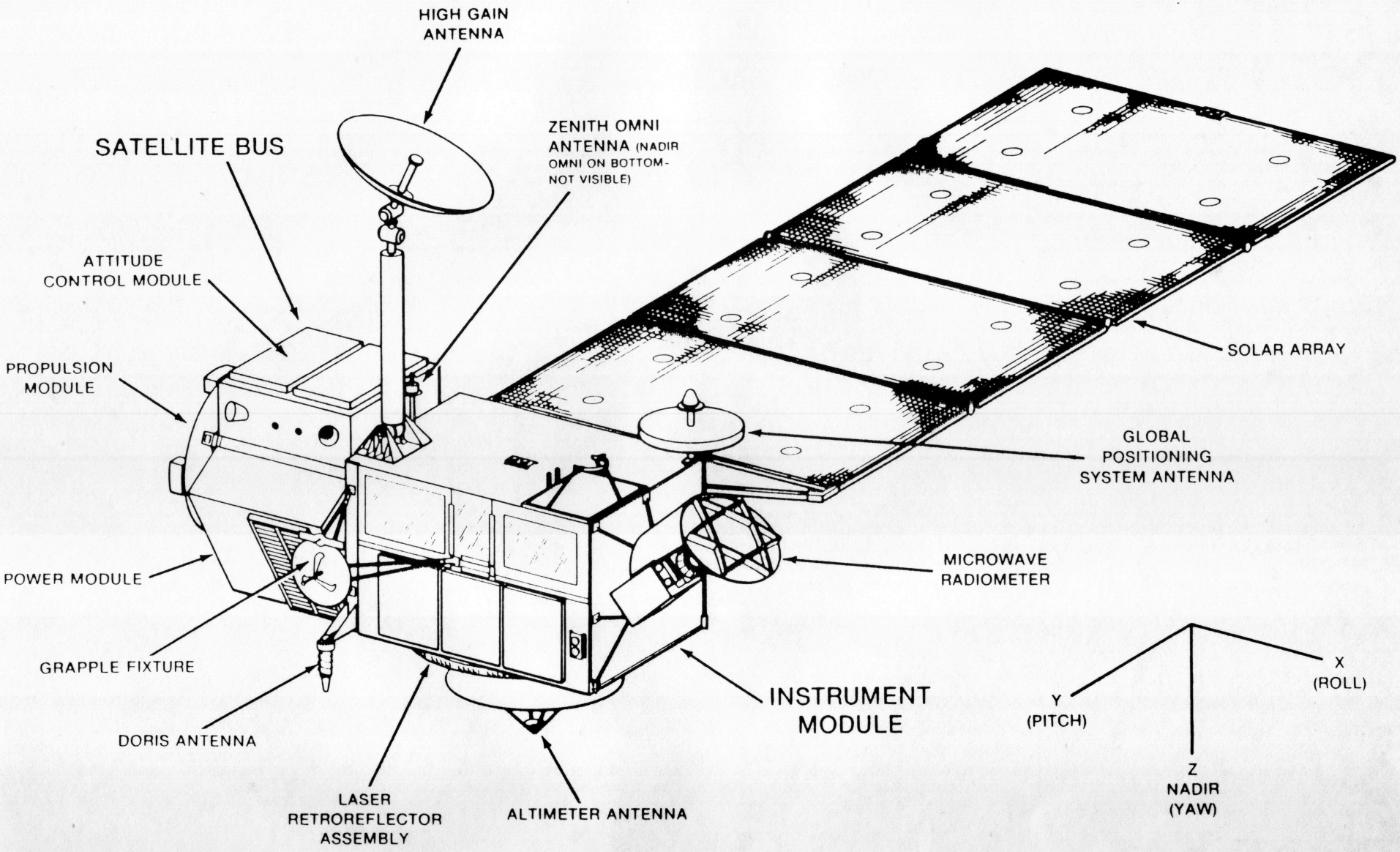
HIGH GAIN ANTENNA
SATELLITE BUS
ZENITH OMNI ANTENNA (NADIR OMNI ON BOTTOM-NOT VISIBLE)
ATTITUDE CONTROL MODULE
PROPULSION MODULE
SOLAR ARRAY
GLOBAL POSITIONING SYSTEM ANTENNA
MICROWAVE RADIOMETER
POWER MODULE
GRAPPLE FIXTURE
DORIS ANTENNA
INSTRUMENT MODULE
LASER RETROREFLECTOR ASSEMBLY
ALTIMETER ANTENNA
X (ROLL)
Y (PITCH)
Z NADIR (YAW)